

APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: DEVICE FOR COMPENSATING FOR HEAT DEVIATION IN A MODULAR IC TEST HANDLER

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DEVICE FOR COMPENSATING FOR HEAT DEVIATION IN A MODULAR IC TEST HANDLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

[1] The invention relates to a handler for testing a modular integrated circuit (IC). More particularly, the invention relates to a device for compensating for heat deviation in a modular IC test handler.

2. Background of the Related Art

[2] In general, a modular IC, having a plurality of IC chips and other devices soldered on a substrate to form an integrated circuit, is subjected to various tests, after fabrication and before shipment, in order to inspect for defects. The modular IC has a very important function with respect to the different components mounted on a mother board of a computer, and thus discovering defects prior to installation is very important.

[3] FIG. 1 illustrates an exemplary modular IC test handler for automatic loading/unloading and testing modular ICs. The modular IC test handler of FIG. 1 includes a loading part 1 for mounting a plurality of modular ICs positioned on a tray on a test carrier C, a pre-heating chamber 2 through which the test carriers C, each having a tray of modular ICs mounted thereon, are conveyed in succession by a conveyor (not shown) and then heated/cooled to a preset temperature, a test chamber 3 for mounting the modular ICs disposed on the carrier C on a test socket 7 connected to an external testing device and carrying out testing, a defrosting chamber 4 for cooling or heating the modular ICs by

cooling or heating the respective carriers C so that the modular ICs return to an initial room temperature state, and an unloading part 5 for separating tested modular ICs from the carrier C, classifying, and then loading the modular ICs on designated trays according to a test result. The modular IC test handler carries out a room temperature test, a high temperature test, and a low temperature test within a preset temperature range.

[4] However, heat generated in the modular IC itself during testing, when the modular IC is mounted on the test socket 7 in the test chamber 3, not only damages the modular IC, but also impedes testing within an accurate temperature range, resulting in poor testing efficiency. Accordingly, in the related art, a device for compensating for heat deviation was developed and employed for solving the foregoing problem. In the related art device, a sprayer fitted to a press unit, which presses and connects the modular IC to the test socket, sprays cooling fluid, such as liquid gas, for example, liquid nitrogen, toward the modular IC, thereby suppressing heat deviation in the modular IC.

[5] However, the related art device for compensating for heat deviation has poor heat compensation efficiency because, though the cooling fluid is designed to be sprayed toward and between a plurality of modular ICs connected to the test sockets, the cooling fluid can not be directly sprayed onto a surface of the modular IC chip, the actual heat generating body, which is attached to a respective modular IC.

SUMMARY OF THE INVENTION

[6] An object of the invention is to solve at least the above problems and/or disadvantages and to provide at least the advantages described hereinafter.

[7] Accordingly, the invention is directed to a device for compensating for heat deviation in a modular IC test handler that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[8] One object of the invention is to provide a device for compensating for heat deviation in a modular IC test handler, in which cooling fluid is directly sprayed onto a surface of ICs mounted on a modular IC during testing.

[9] To achieve at least these and other advantages and in accordance with the purposes of the invention, as embodied and broadly described, a device for compensating for heat generation in a modular IC test handler configured to receive cooling fluid from an exterior source and spraying the cooling fluid onto modular ICs during testing is provided according to an embodiment of the invention, wherein the device is attached to a press unit including a frame, and a plurality of push bars are arranged at fixed intervals on a front surface of the frame for pushing edges of modular ICs mounted on carriers to connect the modular ICs to test sockets. The device for compensating for heat deviation according to an embodiment of the invention includes at least one supporting member provided adjacent to the press unit and having a cooling fluid flow passage formed therein for flow of cooling fluid, and at least one cooling fluid spraying unit configured to spray the cooling fluid supplied through the cooling fluid flow passage toward faces of modular ICs in an oblique direction. The invention improves cooling efficiency as cooling fluid is sprayed from the spray holes toward a surface of the modular IC on which ICs are attached.

[10] The cooling fluid flow passage may include a plurality flow passages divided, respectively, by partitions extending in a lateral direction. For example, the cooling fluid flow

passage may include an upper flow passage, a middle flow passage, and a lower flow passage. The upper flow passage may be in communication with end parts of the nozzle members. The lower flow passage may include an inlet at one side for receiving cooling fluid from an exterior source. The partitions may have a plurality of connection holes positioned at fixed intervals for flow of the cooling fluid introduced thereto through the lower flow passage, the middle flow passage, and the upper flow passage. Ends of the nozzle members and the connection holes may be arranged staggered with respect to one another, thereby compensating for pressure heads and providing a comparatively uniform spray of cooling fluid through the nozzle members.

[11] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objects and advantages of the invention may be realized and attained as particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[12] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention:

[13] FIG. 1 is a schematic view of a related art exemplary modular IC test handler for automatic loading /unloading and testing of a modular IC;

[14] FIG. 2 is a schematic side view of a test chamber in a modular IC test handler having a device for compensating for heat deviation in accordance with an embodiment of the invention;

[15] FIG. 3 is a schematic front view of a press unit having a device for compensating for heat deviation in accordance with an embodiment of the invention;

[16] FIG. 4 is a schematic perspective view of a device for compensating for heat deviation in accordance with an embodiment of the invention, with a partial cut away view designated as 'A';

[17] FIG. 5 is an enlarged schematic view of the partial cut away view designated as 'A' in FIG. 4;

[18] FIG. 6 is a schematic cross-sectional view taken along line I-I in FIG. 3;

[19] FIG. 7 is a schematic drawing explaining flow of cooling fluid in a cooling fluid flow passage formed in a supporting member in the device for compensating for heat deviation of FIG. 4; and

[20] FIG. 8 is a schematic drawing illustrating operation of a device for compensating for heat deviation according to an embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[21] Reference will now be made in detail to embodiments of the invention, examples of which are illustrated in the accompanying drawings. For a better understanding of the system and operation of a device for compensating for heat deviation according to the invention, a test chamber in a modular IC test handler having a device for compensating for

heat deviation according to an embodiment of the invention will be hereby described with reference to FIG. 2.

[22] Referring to FIG. 2, a test chamber 3 includes an air tight openable/closable housing 31 having a test socket 7 connected to an external test device (not shown). The test socket 7 is configured for electric connection to a modular IC 'M' disposed on a carrier 'C' and conveyed into the housing 31 for carrying out testing. A press unit 36 is movably mounted at a rear of the test socket 7 in the housing 31 for pushing the modular IC forward to connect the modular IC to the test socket 7 when the carrier C is positioned adjacent the test socket 7. A motor 37 and a ball screw 38 are coupled to the press unit 36 from outside the housing 31, which move the press unit 36 back and forth.

[23] The test chamber 3 also includes a cooling and heating device 50 for bringing an inside of the test chamber 3 to a required temperature. The cooling and heating device of FIG. 2 includes a spray nozzle 33 connected to a source of cooling fluid (not shown), such as a cooling fluid tank for spraying a cooling fluid, such as liquid gas, for example, liquid nitrogen, and an electric heater 32 for generating heat electrically. A fan 34 is disposed at one side of the spray nozzle 33 and the electric heater 32. The fan 34 blows the cooling fluid sprayed from the spray nozzle 33 or hot air heated by the electric heater 32 toward the carrier C. As shown in FIG. 2, a guide duct 35 guides the cooling fluid or the hot air blown by the fan 34 toward the carrier C.

[24] In the meantime, a device 10 for compensating for heat deviation according to the invention is attached to the press unit 36 and directs a spray of cooling fluid onto a surface of the modular IC under test, either continuously or intermittently. The system and

operation will be described, with reference to FIGS. 3~8. The press unit 36 will first be described with reference to FIG. 3.

[25] Referring to FIG. 3, the press unit 36 includes a frame 361, which in the embodiment of FIG. 3 is substantially rectangular, although other shapes may also be appropriate. A plurality of push bars 362 is arranged at fixed intervals on a front surface of the frame 361 for pushing edges of the modular ICs mounted on the carrier C to connect the modular ICs to the test socket 7.

[26] The device 10 for compensating for heat deviation includes supporting members 11 fixed, respectively, to an upper end and a lower end of the frame 361 of the press unit 36. Each supporting member 11 has a cooling fluid flow passage therein. A plurality of hollow nozzle members 12 have ends in communication with the cooling fluid flow passage in the supporting members 11, as shown in FIG. 3. The nozzle members 12 shown in FIG. 3 are substantially 'U' formed bars; however, other configurations may also be appropriate. In the embodiment of FIG. 3, the nozzle members 12 are arranged at fixed intervals along the supporting members 11 such that each of the nozzle members 12 is disposed between adjacent push bars 362. However, other arrangements may also be appropriate.

[27] Each nozzle member 12 has a plurality of spray holes 13 positioned at intervals along a length direction of the nozzle member 12. In the embodiment of FIG. 3, the spray holes 13 are arranged in pairs, wherein each pair of the spray holes 13 are formed adjacently in a circumferential direction such that the spray holes 13 are directed away from a

central plane formed by the nozzle member 12. The pairs of spray holes 13 are also positioned at fixed intervals.

[28] As shown in FIG. 5, the cooling fluid flow passage in the supporting member 11 may be divided into three layers, including a lower flow passage 113, an intermediate buffer flow passage 114, and an upper flow passage 115 by an upper partition 112 and a lower partition 111. The lower flow passage 113 has an inlet 119 at one end for receiving cooling fluid from an exterior source, and the upper flow passage 114 is in communication with an end of the nozzle member 12.

[29] The upper partition 112 and the lower partition 111 have connection holes 112a and 111a positioned at fixed intervals. The connection hole 112a in the upper partition 112 may be staggered with respect to the end of the nozzle member 12, and the connection holes 111a in the lower partition 111 may be staggered with respect to the connection holes 112a in the upper partition 112. That is, positions of the nozzle member 12 and the connection holes 112a in the upper partition 112 and the connection holes 111a in the lower partition 111 may be in a zigzag form. This configuration eliminates a pressure head from the cooling fluid introduced into the cooling fluid flow passage, providing for uniform spray of the cooling fluid through the nozzle member 12.

[30] If there is only one cooling fluid flow passage, a pressure of the cooling fluid is high in the vicinity of an inlet through which the cooling fluid is introduced, and lower in proportion to a distance from the inlet. Consequently, though spray of cooling fluid at a high pressure can be expected from the nozzle member in the vicinity of the inlet, spray of cooling fluid at a low pressure can be expected from the nozzle member far from the inlet.

This causes an imbalance in overall cooling performance and ineffective heat deviation compensation.

[31] However, if the cooling fluid flow passage is divided into multiple layers, for example, three are provided in the embodiment of FIG. 5, and the connection holes 112a and 111a are staggered with respect to one another, the cooling fluid introduced through the inlet 119 passes through many stages, with gradual correction of the pressure head at each of the stages. This configuration permits spray of the cooling fluid at a comparatively uniform pressure throughout the nozzle member 12, which will be described in more detail below.

[32] An upper part of the supporting member 11 to which the nozzle member 12 is connected includes a lower supporting member 116 having a plurality of pass through holes 116a positioned at fixed intervals for receiving therein ends of the nozzle members 12, and an upper supporting member 117 fastened to a top of the lower supporting member 116 with a fastening device, such as screws, and having pass through holes 117a at positions corresponding to the pass through holes 116a in the lower supporting member 116.

[33] Upper ends of the pass through holes 116a in the lower supporting member 116 and corresponding lower ends of the pass through holes 117a in the upper supporting member 117 may be sloped, such that a '<' shaped groove 118 is formed between the pass through holes 116a and the pass through holes 117a when joined together. A groove 121 may also be formed in the end of the nozzle member 12 at a position corresponding to the groove 118, as shown in FIG. 5.

[34] An elastic sealing device 14, such as an elastic sealing ring, for example, an O-ring, may be provided between the groove 118 and the groove 121 in the nozzle member 12,

so that the end of the nozzle member 12 does not fall off of the pass through holes 116a and 117a. The sealing ring 14, not only holds the nozzle member 12 in the pass through holes 116a and 117a, but also positions and seals the nozzle member 12 with respect to the supporting member 11 when the nozzle member 12 is attached to the supporting member 11. The sealing ring 14 may be formed of silicone or rubber; however, other materials may also be appropriate.

[35] The operation of a device for compensating for heat deviation according to an embodiment of the invention will be described below.

[36] Once the press unit 36 presses and connects modular ICs mounted on the carrier C to the test sockets 7, the testing proceeds. Cooling fluid is supplied to the lower flow passage 113 from an external cooling fluid source (not shown) through the inlets 119 in the supporting members 11 of the device 10 for compensating for heat deviation according to an embodiment of the invention.

[37] Referring to FIG. 7, the cooling fluid introduced into the lower flow passage 113 is introduced into the intermediate buffer flow passage 114 through the connection holes 111a in the lower partition 111. Since portions of the connection holes 111a in the lower partition 111 are obstructed by the upper partition 112, the cooling fluid is dispersed and mixed in the intermediate buffer flow passage 114, thereby correcting a primary pressure head.

[38] Next, the cooling fluid is introduced into the upper flow passage 115 from the intermediate buffer flow passage 114 through the connection holes 112a in the upper partition 112. The cooling fluid is dispersed and mixed in the upper flow passage 115,

thereby correcting a secondary head as portions of the connection holes 112a in the upper partition 112 are also obstructed by the lower supporting member 116. Then, the cooling fluid is introduced into the nozzle members 12 through ends of the nozzle members 12.

[39] Thus, since the cooling fluid introduced through the lower flow passage 113 is involved in two pressure head corrections before it is introduced into the nozzle members 12, cooling fluid with a comparatively uniform pressure is supplied to the nozzle members 12.

[40] Referring to FIG. 8, the cooling fluid introduced into the nozzle members 12 is discharged through the spray holes 13 in the nozzle members 12 in an oblique direction with respect to a central plane containing axes of the nozzle member 12. The cooling fluid is directed toward the IC chips positioned on both sides of the modular IC M mounted on the test socket 7, as the spray nozzles 13 are directed away from the central plane, and excellent cooling performance is achieved.

[41] Along with improved cooling performance, the invention may provide the advantage of simple attachment of the nozzle members 12 to the supporting members 11. That is, when the nozzle member 12 is attached to the supporting members 11, after ends of the nozzle member 12 are inserted into the pass through holes 117a in the upper supporting member 117, the sealing rings 14 may be inserted from lower ends of the nozzle member 12 and positioned in the grooves 118 and in the grooves 121 of the nozzle member 12. The ends of the nozzle member 12 are inserted into the pass through holes 116a in the lower supporting member 116 so that the lower supporting member 116 and the upper supporting member 117 are joined.

[42] In general, the cooling fluid used for the heat deviation compensation is a liquid gas, such as liquid nitrogen. That is, a mixed cooling fluid of liquid nitrogen and dry air may be utilized to prevent formation of frost caused by moisture.

[43] As has been described above, the device for compensating for heat deviation according to an embodiment of the invention provides at least the following advantages.

[44] Excellent cooling performance is achieved because cooling fluid is sprayed in an oblique direction from the nozzle member directly toward IC chips mounted on a modular IC during testing.

[45] Further, the supply of the cooling fluid to the nozzle member passes through many stages, permitting supply of cooling fluid to the nozzle member at a uniform pressure, thereby further enhancing the effect of heat deviation compensation.

[46] Additionally, easy attachment of the nozzle members to the supporting members shortens the assembly process.

[47] The foregoing embodiments and advantages are merely exemplary and are not to be construed as limiting the invention. The present teaching can be readily applied to other types of apparatuses. The description of the invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures.